LETTERS TO THE EDITOR

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On the Mechanical Work done in exhausting a Muscle

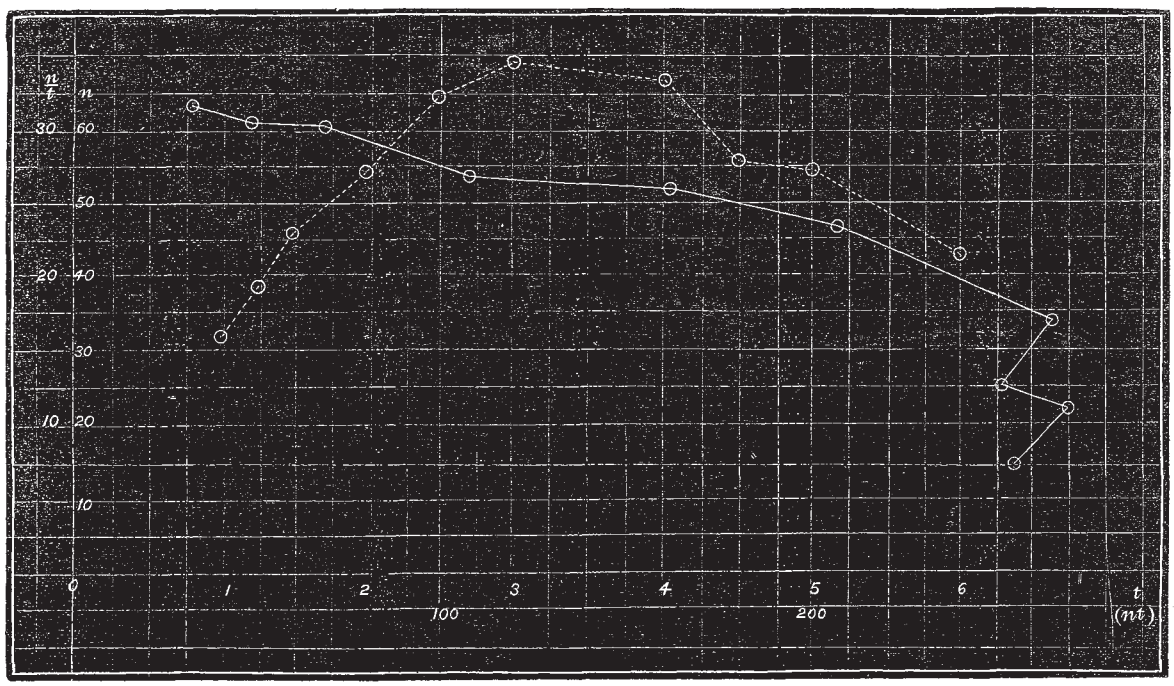
I BEG leave to make some reply to the comments (NATURE, vol. xi. pp. 464, 488) of Prof. Haughton on my paper.

1. In regard to the relative value of my earlier and later experiments, it is to be said, that in one sense they are all equally valuable. My object, however, was to find the work of exhaustion when the intervals of work and rest were equal, the work to be expended only in lifting the weight. Hence the experiments were made in such a way as to eliminate the fatigue caused by the falling weight. Prof. Preston and myself practised for several weeks, until we were able to keep accurate time, before the published series was begun. All who saw the experiments were then satisfied that the later method of experiment was an improvement. The two series first published were made with equal care, and I am therefore at some loss to know what has been Prof. Haughton's criterion in deciding that one was good and the other bad.

2. In dealing with Prof. Haughton's equation—

$$n = \frac{A.t}{1 + \beta t^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

when it was said that the co-ordinated values of $\frac{n}{t}$ and $n.t$ formed a curve, the meaning could only have been that β is not a constant. Prof. Haughton is of course right in saying that the observations thus co-ordinated "may be represented by a straight line." He might also have added that for properly chosen limits, any other observations may also be represented by a straight line. The point is, whether these lines give any evidence of regular deviations. It seems to me that "any one accustomed to such observations" ought to be able to see such evidence in the diagrams of Prof. Haughton in NATURE, *loc. cit.* In this connection I wish to give a series of experiments, the time of lift t being variable and equal to the interval of rest. The values of n are the means of four experiments, and are uncorrected for variations in strength. The experiments were made with the



apparatus described in my last paper (NATURE, vol. xi. pp. 256, 276) and my right arm.

Raising weight of 4·5 *kgr. through* 0·70 *in* t *sec.*

t	n	$\frac{n}{t}$	$n.t$
1·00	31·7	31·7	31·7
1·25	38·7	30·6	48·4
1·50	45·5	30·3	68·3
2·00	54·0	27·0	108·0
2·50	64·7	25·9	161·8
3·00	69·2	23·1	207·6
4·00	66·5	16·6	266·0
4·50	56·0	12·4	252·0
5·00	54·0	10·8	270·0
6·00	42·5	7·1	255·0

The values of n and t are represented in the diagram by the dotted line. It will be seen that n reaches a maximum where $t = 3{\cdot}4$.

The values of $\left(\frac{n}{t}\right)$ and $(n.t)$ are also represented by the full line. It will be observed that the observations on opposite sides of the maximum n are not continuous. A comparison of this line with those given by Prof. Haughton in NATURE, vol. xi. p. 465, will be found instructive.

3. In the case just considered, the time of exhaustion depends upon the velocity of disintegration and recuperation of the muscles. It is well known that the velocities of such operations, taking place in time, are represented by the binomial curve. I have satisfied myself that the values of n in the above series are represented by the terms of the expanded binomial $(p + q)^m$ where $p + q = 1$; where p and q are unequal, and where $m = 1$ represents the total number of chances. This point is reserved for future investigation.

4. In my paper in the *American Journal of Science* (Feb. 1875, pp. 130–137), the accuracy with which Prof. Haughton's formula represents my experiments, was shown. Assuming

$$(w + a)\, hn = \frac{A}{(w + a)^v}$$

where a is the reduced weight of the arm, and Prof. Haughton's law demands that $v =$ unity. It turns out to be 2·6. Prof.

Haughton refers the difficulty to my experiments, and I refer the difficulty to his theory.

5. Prof. Haughton objects to my reduction for variations in strength. In reply, it is to be said that an increase of from 13·66 kgr. to 14·84 kgr. in the strength of Mr. Myer's arm, caused n to vary from 78 to 1366. The weight used was 5·00 kgr. For a weight of one or two kgr. my own arm also varies thus greatly. I therefore conclude that this reduction is not only not improper, but that it is essential.

6. I beg leave to state that I alone am responsible for the paper published in NATURE, vol. xi, pp. 256–276. I acknowledged therein all the aid that I am conscious of having received. F. E. NIPHER

Washington University, St. Louis

P.S.—I find that one important point in Prof. Haughton's paper has been overlooked in my reply. Objection is made to my last series of experiments, on the ground that all the muscles thrown into action are not exhausted. If this objection is well taken, it applies also to the former series of mine, so "highly confirmatory of the Law of Fatigue," the agreement of which with Prof. Haughton's formula is so "complete and satisfactory." The *lifting* of the weight was done in precisely the same way.

Domestic Economy of Blackbirds

TWO Blackbirds having built their nest in full view of my bedroom window, I have been much interested in watching the process of feeding their young, &c. The cock bird is the principal forager, and the food generally brought are worms. My object in writing is to draw attention to one feature which may be unknown to most of your readers as relates to the disposal of the young birds' droppings. If left in the nest, it would become filthy, if thrown aside the accumulation would lead to detection, and I believe the general impression is that the old birds carry the soil away; but on watching them closely I never saw the droppings carried away but on one occasion, and that by the hen; in every other instance after being fed, the young birds in turn lift up their tails and the droppings are taken by the old bird and actually swallowed. On the 15th July the young birds being fully fledged, were literally washed out of their nest by the downpour of rain on that day, but, with a little care, they all survived. On the 22nd the hen again returned to her nest, and she is now sitting closely on three eggs, and I hope to get the next brood photographed. I enclose my card and address, and should any readers of NATURE desire to witness what I have described, I shall be very glad to afford them an opportunity.

Woolwich Common, 2nd Aug., 1875 E. R. W.

Scarcity of Birds

MR. BARRINGTON, writing from the Co. Wicklow, in NATURE, vol. xii. p. 213, says that he finds Blackbirds and Thrushes unusually scarce this year. I have not heard of this anywhere else, and certainly it is not the case here.

Old Forge, Dunmurry, JOSEPH JOHN MURPHY
Co. Antrim, July 26

Hay Crops of 1875

LET me record in NATURE the extraordinary fact that on Monday, July 26, in one of my meadows here, the first crop was carried while the second crop, or after-math, was being cut.

Valentines, Ilford C. M. INGLEBY

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—The last number of *Vierteljahrsschrift der Astronomischen Gesellschaft* (x. Jahrgang, weites Heft), received within a few days, contains an ephemeris of most of the known variables, including those of short period, for the year 1876, drawn up by Dr. Schœnfeld, chiefly from the data in his catalogue of 1875. This early publication will, no doubt, be very acceptable to observers who are devoting attention to these interesting and puzzling objects.

THE GREAT CLUSTER, MESSIER 11.—As the first special publication of the Observatory of Hamburg, we have Prof. Helmert's memoir detailing the results of his micrometrical observations on the components of this well-known cluster in the constellation Aquila, or in *Clypeum* or *Scutum Sobieski*, as many of the Continental astronomers continue to call that part of the heavens in which it is situate. The memoir has a particular interest from the circumstance of Dr. Lamont having similarly employed the Munich refractor in the years 1836-39. The investigation of any changes that may take place in the constituents of these groups of stars, as regards position or brightness, becomes a very attractive one, and as we know from the excellent work of Herr Pihl on the Perseus cluster, it is not one always requiring the use of large instruments, such as have been employed in the hands of Lamont and Helmert, upon Messier 11. D'Arrest terms this cluster "magnifica innumerabilium stellarum coacervatio"; the amateur will remember Admiral Smyth's comparison of the configuration of the components to "a flight of wild ducks."

NEW MINOR PLANET.—No. 147 of this group was detected by Herr Schulhof, at the observatory of Vienna, on July 10, in the vicinity of β Capricorni. It is of the twelfth magnitude, and Prof. Littröw, the director, proposes to call it "Protogeneia," perhaps in allusion to it being the first minor planet discovered at this observatory. It may be presumed that he has satisfied himself of its distinctness from any of the minors which are now adrift.

THE GREAT COMET OF 1843.—The elements of the orbit of this remarkable body, finally derived by the late Prof. Hubbard, of the Naval Observatory, Washington, after a very masterly discussion of the whole series of observations, are as follow :—

Perihelion Passage 1843 February	27·41051	G.M.T.
Longitude of Perihelion ...	278° 40′ 17″	M. Eq. 1843.
,, Ascending Node	1 14 55	M. Eq. 1843.
Inclination of Orbit	35 40 39	
Excentricity	0·999915717	
Perihelion Distance	0·00055383	

Motion—retrograde.

From which we have the following additional figures :—

Mean Distance from the Sun ...	65·711
Aphelion Distance	131·42
Period of Revolution	532·7 years.

The distance from the sun at the perihelion is less than that of any other comet so far computed; the famous comet of 1680, according to Encke's definitive calculations, making also a very close approach, though not so near as in the present case. If Leverrier's semi-diameter of the sun be adopted, with 8″·875 for the solar parallax, we find—

Sun's semi-diameter	428,710 English miles.
Comet's perihelion distance ...	510,140 ,,

Whence it would appear that a little before 10 P.M. on February 27, the comet passed within 81,500 miles from the sun's surface, and if we compute the orbital velocity at the time, we find it 348·5 miles per second. The comet was less than $2\frac{1}{4}$ hours on the north side of the ecliptic, passing from ascending to descending node in 2h. 13·4m.

On examining with the above elements the track of the comet on the day of perihelion passage, it results that a transit over the sun's disc must have taken place at the descending node, the ingress (geocentric) occurring at 11h. 28m. Greenwich time, 241° from the sun's N. point towards E., and the egress at 12h. 29m., at 187° similarly reckoned. The transit might have been observed in Australia; the times for Sydney being, Feb. 27, 21h. 33m. for ingress and 22h. 34m. for egress. Such a transit brings to recollection an observation recorded in the Paris Astronomical Bulletin at the time as having been made by M. Aristide Coumbary at the observatory of Constantinople, on the morning of the 8th of May, 1865, from which it would appear that a dark spot moved over a space of 21′ upon the sun's disc, in a little over three-